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## THE ROLE OF SOCIAL BEHAVIOR IN MYCOBACTERIAL INFECTION MANAGEMENT: A CASE STUDY OF PASTORAL COMMUNITIES OF UGANDA

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### ABSTRACT

In sub-Saharan African arid pastoral regions, the socio-behavioral indigenous knowledge mystical systems associated with actions and response by communities to mycobacterial infections in the pastoral ecosystems of Uganda remains largely unknown in Uganda and across the African continent. These drivers are important as they often magnify the problems linked to co-infection with HIV/AIDS. This study sought to determine the socio-behavioral, indigenous knowledge mystical systems and other factors associated with mycobacterial infections and their management among the pastoralist communities. Socio-demographic, environmental, and household-level behavioral and attitudinal variables data was collected through a cross sectional questionnaire-based study administered to a total of 301 pastoralists from Mubende and Nakasongola pastoral districts of Uganda. In addition, key informant interviews and focus group discussions were conducted. Consumption of raw and half cooked animals' products, drinking untreated water, and smoking as well as sharing of cigarette sticks and drinking straws, coughing and spitting, and excessive alcoholism were the socio-behaviors perceived to expose the pastoralist communities to mycobacterial infections. Stigmatization was related to chronic illness and faith-based perceptions facilitated mycobacterial infection transmission. Involvement in the risky production actions and social livelihood ventures such as charcoal production are perceived as being responsible for mycobacterial

infection transmission. High degree of stigmatization, discrimination (S&D) and abandonment of the patients suffering from mycobacterial infections among the pastoralist communities have been revealed. Socio-consumption behaviors were perceived the main routes for acquisition of mycobacterial infections. Pastoralist communities perceived that livestock act as sources of mycobacterial infections and therefore pose a health threat to the humans living at the human-animal interface.

Keywords: Mycobacterial infections, pastoralists, socio-behaviours, stigmatization

## INTRODUCTION

Mycobacterial infections cause global public health and socio-economic problems in both human and animal populations, particularly in developing countries<sup>1</sup>. Members of the genus *Mycobacterium* such as *Mycobacterium tuberculosis*, *Mycobacterium bovis*, and non-tuberculosis mycobacteria (NTM) are known to cause infections in both humans and animals<sup>2</sup>. In the HIV/ AIDS era, mycobacterial infections have become a subject of renewed interest because of the potential of co-infection between mycobacterial infections and HIV/AIDS, especially in Asia and sub-Saharan Africa<sup>3-4</sup>. Indeed, it has been estimated that one-third of HIV/ AIDS deaths are due to mycobacterial infections, particularly TB<sup>5</sup>. NTM infections are emerging environmental pathogens that are not frequently reportable and also responsible for causing opportunistic infection in both immune compromised and non- immune compromised persons alike<sup>6</sup>.

In such scenarios where mycobacterial infection incidences are on the rise, poverty remains an overwhelming risk factor for mycobacterial related mortalities<sup>7</sup>. Therefore mycobacterial infections and poverty are closely associated. Although all ranks of a society can acquire the disease, the poor are at a greater risk. This is because they are in greater contact with other sufferers e.g in crowded homes or in prone social gatherings. Further, among the poor communities, the immune system is weakened due to poor nutrition<sup>8</sup>. Thus malnutrition, overcrowding, poor indoor air circulation and poor sanitation are other factors associated with increasing poverty, and increase the risk of getting infected by mycobacterial infections<sup>4, 9</sup>. Currently, Uganda is ranked the 16<sup>th</sup> among the world's 22 countries most heavily burdened by tuberculosis<sup>5</sup>. At the same time, there is little or no documentation on the risk factors for infection with NTM in Uganda, even though *M. tuberculosis* is the most prevalent species of the *M. tuberculosis* complex found in Kampala city, with the Uganda genotype being the predominant strain<sup>10</sup>.

The picture on mycobacterial infections might be even more complex in rural farming ecosystems of Uganda where there is close interaction between humans, livestock, and wildlife<sup>5,11</sup>. Recent studies show that *M. bovis* and a wide range of species of NTM has been isolated and characterized from shared environment<sup>12</sup>, humans, and animals (cattle and pigs)<sup>13-15</sup>. Hard-to-reach pastoral areas present a further complication to this picture. Pastoralists are well known to occupy the cattle corridor, running diagonally across Uganda from the northeast parts of Karamoja district to the southwestern parts through the central region districts. Mubende and Nakasongola districts are located in the central part of the Ugandan cattle corridor<sup>16</sup>. In the cattle corridor, recent studies indicate an increasing problem with mycobacterial infections among farming communities, and their

animals<sup>11, 14</sup>. Pastoral ecosystems also harbor different species of wildlife that can serve as reservoirs for disease. In such areas, large herds of cattle, domestic animals such as goats and sheep, wildlife, and humans all share the same community pool resources (CPR) such as community valley dam water and grazing grounds, providing opportunities for continued close interaction, and consequently increasing the potential risk of mycobacterial infection to the communities living at the human-environment-livestock-wildlife interface (HELI)<sup>11</sup>. A further social behavioral challenge encountered by mycobacterial infected patients of the pastoral areas of Uganda is the social stigma which is increasingly recognized due to the association of mycobacterial infections with HIV<sup>17-19</sup>.

Effective community-based mycobacterial infection prevention and control measures require comprehensive initiatives that address the primary barriers for the prevention of mycobacterial infection. In this regard, understanding the socio-behavioral that influences pastoralist perceptions, actions, and responses to mycobacterial infections and associated infections such as HIV/ AIDS and opportunistic illness is a very important aspect<sup>20</sup>. Despite evidence of the potential avenues of mycobacterial infection spread across humans/ livestock/ wildlife, little or no critical attention has been given to the public health impact of mycobacterial infections on individuals, families and communities in the most at-risk areas such as the pastoral ecosystems of Uganda.

This study seeks to address this gap by determining the socio-behavioral, indigenous knowledge mystical systems, and other associated factors that influences the pastoral communities' perceptions, actions, and responses to mycobacterial infection management among the pastoral communities of Uganda.

## MATERIALS AND METHODS

As a follow up to the earlier studies<sup>11-12</sup> conducted in the same districts, two sub-counties were selected and studied for a period of three months (January –March). The study sub-counties were Kiyuni and Madudu in Mubende district and Nabiswera and Lwampanga in Nakasogola district. The areas selected for this study are representative of the typically resource-poor districts in the central Uganda region<sup>21-23</sup>. In addition, both districts have limited access to social and health services. The selected districts of Mubende and Nakasongola, compared to the national HIV/AIDS prevalence of 7%, have higher prevalence rates of 17 % and 18 % respectively<sup>22-23</sup>.

### A. Study design and participants

A cross-sectional study utilizing a questionnaire as a survey tool for collecting pertinent data was conducted. A standardized closed-ended questionnaire was first pre-tested for confounders to reduce bias such as recall and intrinsic and external validity confounders by the research team. Administration of the questionnaire was through “face to face” interviews by the trained interviewers who posed standard questions to all the selected participants. Pre-testing was conducted in Kayunga district, inhabited by pastoral tribes and located 40 km north of Kampala city, with similar semi-arid conditions and ecological settings as the study areas. Standardization was achieved by establishing a questionnaire in English that was easily translatable into any of the local languages

(Luganda, Ruruli, Runyankore and Runyoro) before use and then re-translated to English. This questionnaire standardization process allowed for standardization of the questions and corresponding responses across different pastoral ecosystems and the tribes therein. Data on socio-demographic, socioeconomic, behavioral, and attitudinal variables that influence pastoralist perceptions, actions, and responses to mycobacterial infection were collected through this formulated questionnaire survey. Table 1 highlights selected household social and demographic characteristics of the sample.

Table 1. Socio-demographic factors of the respondents split by districts. (n=301, Mubende =164, Nakasongola =137; P-values from Chi-square analysis).

Variable type	Level	District				P-value
		Proportion Mubende	%	Proportion Nakasongola	%	
Household headship	Male	109	36	105	35	0.05
	Female	55	18	32	11	
Sex	Male	101	34	90	30	0.46
	Female	63	21	47	16	
Education level	No formal education	40	13	39	13	
	Primary level	106	35	67	22	<0.001
	Secondary	17	6	17	6	
Tribes	Baganda	122	41	33	11	<0.001
	Baruli	4	1	47	16	
	Banyankole	6	2	37	12	
	Other tribes	32	11	20	6	
Occupation	Pastoralist	14	5	51	17	<0.001
	Agro-pastoral	122	41	46	15	
	Crop& other livestock ( pigs & Poultry)	28	9	40	13	

In addition, we also used a qualitative study design where Focus Group Discussions (FGD) and key informant semi structured interviews were conducted. Community meetings were initially held to identify FGD participants and key informants. With the participants or groups, the meetings and discussions were conveniently held at agreed periods and venues. Each group consisted of 8-14 persons, and discussions were held in local languages. Discussions were moderated and guided using an FGD guide or checklist developed by the research team. After obtaining consent from the participants,

the discussions were audio taped. In each case, the five FGDs (held in four subcounties of pastoral communities) concentrated on the following aspects: Individual/community social behaviors, indigenous knowledge, and mystical systems existing within the pastoral mycobacterial infection health management structures.

#### B. Sample size determination and sampling strategy

The primary sampling unit was the household (HH) represented by an individual from each independently selected HH. One person (mainly the household head) was earmarked for the face to face interview. In the event that the head of household was not present, any other person (who is a member of the selected household) found at that particular time of household visit was interviewed.

The sample size was determined based on the previous studies of prevalence and mortalities associated with mycobacterial infections in HIV- TB co- infected patients in rural Uganda <sup>24</sup>. Recent studies indicated the presence of potentially pathogenic NTM species in the environment <sup>12</sup>. In the pastoral communities of Uganda, studies have shown a prevalence of mycobacterial infection of about 4.5% <sup>14</sup>. Based on reports on the population by the district-level National Environment Management Authority (NEMA) <sup>21 - 23</sup> and the simple assumption that the study needed an absolute minimum of 10 households with mycobacterial infection in the study population, we opted for 301 as a necessary minimum number of households, which further served to provide a reliable comparison between population factors at a prevalence of 10-20 % <sup>25</sup>. The selection of study households was based on the list of households obtained in collaboration with the community local leaders in the respective sub-counties. A systematic sampling approach was used whereby every seventh household on the household list was chosen and interviewed.

#### C. Data analysis

##### Qualitative data:

FGDs were translated and transcribed into English. The researcher read through all the transcripts several times while making notes on the transcripts to make sense of the texts. Quotes that best described different social behaviors, indigenous knowledge, and mystical systems existing within the pastoral mycobacterial infection health management systems and expressions that were aired frequently in several groups were chosen. Events, perceptions, actions, and responses relating to mycobacterial infections were identified and noted by the researcher.

##### Quantative data:

The database was collated in MS Excel before transferring to Stata SE for Windows/ version 11 (StataCorp, College Station, TX, USA). All handling, validating, cleaning, and coding of data utilized MS Excel, while the data analysis employed Stata.

Socio-demographic factors of the individual respondents related to the actions and responses of the selected households or communities to mycobacterial infection

management was collected and documented. This information was further compared to what communities perceived and how they acted or responded in mycobacterial infection management.

Cross tabulations were done using district as a key variable versus other socio-demographic factors of the individual respondents, and community perceptions on mycobacterial infection transmission. The corresponding p-values were calculated (chi-squares) to identify possible group differences.

Univariate linear regression analysis was used to determine social-demographic variables that were relevant for the final mixed effect linear regression model analysis with district random effects. Model testing was done using standard procedures in Stata.

#### D. Ethical consideration

The ethics and research committee of the Uganda National Council of Science and Technology (UNCST) approved the study with a reference: H337. Participation in this study was voluntary and confidentiality was assured.

## RESULTS

#### A. Qualitative study

This section deals with socio-behaviors, pastoralist's perceptions to mycobacterial infections transmission, risky production and social livelihood ventures and actions and community sensitizations and its associated challenges revealed during interviews with the FGD and key informants.

#### Socio-behaviors of pastoral communities

Socio-behavioral attributes such as; consumption behaviors, public conduct, sharing behaviors, smoking and excessive alcoholism are believed to be involved in mycobacterial infection transmission to humans. This has been revealed at different focus group discussion and key informant interviews conducted in the districts of Nakasongola and Mubende, Uganda. There are slight differences in how different communities across the two districts perceived how socio-behaviors enhance the mycobacterial infection transmission among the pastoral communities. Further, the perceived overall risk of the socio-behavior contributes to the community has been ranked by the communities members ranging from low-moderate-high risk with the regard to mycobacterial infection transmission as tabulated in Table 2.

Consumption of raw or half cooked animal products is prominent among some of the community members regardless of the fact that it is perceived to expose them to the mycobacterial diseases. Community members traditionally feed on raw milk and meat products, in most cases this behavior could be traced back in five or more generations in some areas. It has thus become a cultural norm or habit to eat animal products raw.

Table 2. Summary of the perceived socio-behaviours and the perceived level of risk of exposure to mycobacterial infections in the pastoral districts of Mubende and Nakasongola, Uganda.

District / subcounty	Forum Reported ( FGD or Key Informant interview(KII)	Action, attitude and or social behavior	Category of socio-behaviour	Overall perceived risk of exposure to mycobacteria
Nabiswera, Nakasongola	FGD & KII	Eating of raw or half cooked animal products- meat/ milk/ blood. Eating meat from dead wild animals.	Consumption behaviours and attitude	moderate to High
Madudu, Mubende				
Nabiswera, Nakasongola	KII	Eating raw animal products has become a cultural norm		
Nabiswera, Nakasongola	FGD	Drinking untreated water from shared water sources		
Nabiswera, Nakasongola	Observations / KII	Some individuals cough and spitting on ground	Public Conduct and behaviour	moderate to High
Nabiswera, Lwampanga Nakasongola Kiyuni and Madudu, Mubende	FGD& KII	Sharing of the cigarette sticks Sharing the drinking straws while drinking alcohol. Glasses or cups	Sharing attitude and behaviour	moderate to High
Nabiswera, Lwampanga Nakasongola Kiyuni and Madudu, Mubende	FGD& KII	Smoking is a common habit especially men folk. Drinking alcohol all day long is common.	Smoking and alcoholism	moderate to High



Some community members have this to say:

*“Eating raw animal products such as meat, milk, ghee, eshabwe, amakamo and other dairy and meat products is a traditional practice in our community. Meat is consumed raw by some of our community and by other hunters”* (Male Key informant in Nabiswera Nakasongola district. Uganda)

*“Both pastoral women and men have an ancestral belief that they can’t be infected since their grandparents and great grandparents ate raw meat and milk and never died of mycobacterial infections, so why bother drinking treated milk? Therefore our people have made it a cultural norm not to boil milk before consumption”* (Male Key informant in Madudu subcounty, Mubende District, Uganda).

Apart from the consumption of raw or half-cooked animal products, FGD results further indicated that drinking untreated water is another common practice. Community members drinking untreated water from the water sources such as valley dams is a common behavior/practice. In Nakasongola district, open water sources are mainly valley dams which are shared by animals and the communities for survival and rural livelihood. Some members of the communities across the two districts perceive it that boiled water does not taste good compared to untreated water.

Coughing and spitting are common unpleasant behavior among some members of the pastoralist communities, increasing the chance of mycobacterial infection transmission especially in the classical tuberculosis and other pulmonary forms.

It was found that smoking was a common habit although some communities had a perception that smoking was associated to mycobacterial infection transmission especially if cigarette sticks are shared among community members. Key informants reported that:

*“Smoking among is a common habit among our people here. Due to lack of money, a piece of cigarette is shared among more than one persons (ranging from 2- 5 persons)”* (Female Key informant in Madudu Mubende District, Uganda)

Excessive alcoholism was earmarked as one of the fastest growing vices among the pastoral communities, with members reported to drink triple distilled alcohol all day long. This alcohol is consumed from drinking clay pots called *enzogo za malwa* (a mixture of fermented ground sorghum and warm water in clay pots) using dry hollow straws which are so often shared by more than two people. In Kiyuni and Madudu subcounties, Mubende district excessive alcoholism behavior was reported to be the biggest cause of family breakups.

*“You see here in our community we are still poor and backward (ignorance) about mycobacterial disease transmission and preventive strategies. For example as a way to show good friendship, relationship in our community, village members share a small glass of (waragi), local brew, drinking pipes are also shared and there is a lot of alcoholism here.*

*In our community, people can drink all day and appear ever drunk throughout their life time. All these practices predispose our people to mycobacterial diseases and silimu (HIV/AIDS)..... When people are drunk, they tend to engage in sexual relationships with those already known to be “infected with HIV/AIDS”, “sha sha.....sha, we know them, there are those even you cannot miss identifying!!!!!!”* (Male FGD participant in Madudu, Mubende District).

### Pastoralists' perceptions on mycobacterial infections

Results revealed that social stigmatization and some religious beliefs facilitate transmission of mycobacterial infections especially in the study sub counties of Nakasongola district, Uganda (Table 3). Results further revealed high levels of social stigmatization and discrimination (S&D) of the mycobacterial infected patients. There was a noted aspect of high level social stigmatization and discrimination that ensues when an individual is suffering from mycobacterial infections both at individual and family/ community level. In one of the study sub counties, Lwampanga sub county in Nakasongola district, it was noted that individuals who suffer from mycobacterial infections or HIV/ AIDS are socially disqualified and discriminated and this follows their bodies even when they are dead. A key informant in this study communities commented:

*“If a person died from HIV/AIDS and or mycobacterial diseases, the dead would first be buried around home and in the night is exhumed and taken near the water site where the dead body is re-buried. According to community , the intention of re-burying near the waters (specifically Lake Kyioga) was that the body could easily be taken away by the running water as this act is perceived to cleanse the bad omen in the family”* (Male Key informant in Lwampanga subcounty, Nakasongola District, Uganda).

Further community perceptions on mycobacterial infections impact negatively on the health seeking behavior (HSB). Mycobacterial infections are understood to be synonymous with HIV/ AIDS, due to the chronic nature of the mycobacterial disease presentation. Communities therefore respond by tending not go for diagnosis or any treatment as it is known that HIV/ AIDS cannot be cured. This compounds the level of social stigmatization and discrimination and lowers the tendency to seek for health services (HSB).

Some members of the pastoral communities perceived that there is faith-based impact on mycobacterial infection spread and some of the members of the community believe in the religion of praying to God only without seeking any other medication. These categories of Christians or believers are perceived to believe that they are only protected by the blood of Jesus (God), thus ignoring medication to curb the infection. This category are commonly called “Savedees” In Runyakore are locally called “*abazunirwe*”.

*“Some of the saved members of our community behave in a unique manner ..... In event that one of their community or family members falls sick of mycobacterial infection or any other form of disease, these strong church believers opt to kneel down and pray for the patient only with a hope that he or she will heal without any form of treatment.*

*Besides, these savedees perceive it that use of traditional medicines is satanic .We know these religious beliefs put this category of our community at risk of infection and also infecting other community member but what can we do?”* (Male Key Informant in Nabiswera Subcounty, Nakasongola district, Uganda).

Table 3: Summary of the most important perceptions on mycobacterial infections, actions and responses of pastoral communities in the districts Mubende and Nakasongola, Uganda.

District / subcounty	Forum Reported ( FGD or Key Informant interview(KII)	Action(s) and perceptions	Overall type of Perceptions on mycobacterial infection
Nabiswera, Lwampanga Nakasongola	FGD&KII	Chronic illnesses are tagged as HIV cases in pastoral communities. Testing positive for tuberculosis is closely linked to HIV/AIDS Dead are buried near homesteads, exhumed and re-buried near the running water sources to cleanse the bad omen	Social stigmatization that leads to isolation of individuals
Nabiswera, Lwampanga Nakasongola	KII	Ignore medication and opt to pray to God. Traditional medicine perceived satanic. Community members know these strong religious believers( savedees)	Perceptions on religious enhances the transmission mycobacterial infection

Community perceived risky production activities and social livelihood ventures that facilitate the transmission of mycobacterial infections

In Nakasongola and Mubende districts, the community members perceived that rearing livestock especially allowing such animals sleep near humans provides a very close interaction and increase the risk of mycobacterial infection transmission at the human-animal interface. This has been identified as important in increasing the risk of mycobacterial infection transmission to humans and vice versa.

Certain livestock species such as poultry, pigs and goats are reared mainly for income generation, which are useful in most households during times of illness as they provide a ready source of income and a source of coping among affected families. At household level, these animals are sold easily in times of financial difficulties. One of the respondents revealed it this way;

*“We keep these animals in our houses because we want to protect them from thieves. You know it is easy to sell our chicken (poultry) or small ruminants (goats and sheep) than selling a cow. In case of infections, the money we get from these*

*sales is used to meet the cost of transport to the hospitals or distant located health centres or buy other domestic household requirements.*

*.....Unless, the infection has worsened, that is when we may need to sell a cow or two cows depending on the nature of the problem. These animals “are like our banks” and have thus greatly contributed for our survival here in the wilderness” (Female Key Informant in Nabiswera; Nakasongola district, Uganda).*

The use of animal wastes such as urine and cow dung to curb some diseases, and mainly skin related infections are a common behavior among pastoral communities. Community members perceived that animal urine and cow dung, if mixed (concoctions) can work as a medicine for skin disease in both children and adults. Importantly, these animal waste concoctions are known to be traditionally used in HIV/TB co-infections and other infections among the pastoral communities.

Further, results revealed that that charcoal production, one of the avenues of income for the communities also pose a serious health risk due to the smoke from charcoal burning process and physically hard labor associated to it. These economic ventures are perceived to weaken the community members making them prone to mycobacterial infections (Table 4). The FGD explained that during the dry season, charcoal burning and selling was a common practice and one of the major economic activities especially in Nakasongola district. Shrubs and trees vegetation species such as acacia trees as good species for charcoal production. Surprisingly, according to the community, the smoke inhaled by the workers is likely to predispose the workers to infections such as mycobacterial infections as well as predisposition to cancer. Community members say that because of chronic poverty in the area, there is kind of barter trade on- going among these communities where there is “pig-for charcoal” (PFC) trade. Key informant interviews had this to say:

*“Exchange of pigs for cutting trees for charcoal burning and selling. There are informal mutual agreements that are made between the livestock farmer and an energetic group of 4-10 persons (charcoal workers). After having agreed of terms that there will be no exchange for cash, except two large pigs estimated to approximately 400,000 to half a million Uganda shillings will be handed over to the group of charcoal burners up upon completion for the agreed task of cutting and burning charcoal from trees on farms”..... This is one other way our communities are able to raise some income for rural livelihood.*

*Our worry is that even if we need the money, these jobs require a lot of energy, it weakens our people and the smoke from the charcoal is very bad to people’s health” ..... (A Male Key informant in Lwampanga subcounty, Nakasongola District, Uganda).*

Community members perceived that the process of charcoal production greatly predisposes the community members (involved in the activity) to mycobacterial infection.

*“.....Two years ago, one of my uncles died. He was working as a charcoal burner. He also used to sell the charcoal, but he died while he was so thin and was coughing a lot, sometimes his sputum had blood. He used to spend a lot of time in those rangelands cutting trees and burning charcoal. Charcoal burning*

*was the only way he would make money for his survival”* (A 34 year old Female FGD participant, Lwampanga subcounty, Nakasongola District, Uganda).

Table 4. Summary of the most important risky production, social rural livelihood ventures and health actions associated with exposure to mycobacterial infections in the pastoral community districts of Mubende and Nakasongola, Uganda.

District / subcounty	Forum Reported ( FGD or Key Informant interview(KII)	Action(s) associated with production enterprises and social rural livelihoods related to mycobacterial infection	Outcome of the actions	Degree of risk of exposure to mycobacterial infection
Nabiswera, Lwampanga Nakasongola, Kiyuni, Mubende	KII	Rearing poultry, pigs and goats. At times kept in the same shelters with humans especially at night. This provides for close human – animal interaction	Provide supplementary Income sources in times of illnesses.	Moderate to High
Nabiswera, Lwampanga Nakasongola	FGD&KII	Use of animal waste such as urine in skin illnesses.	Traditional medicine and concoctions for healing some skin diseases	Low to Moderate
Nabiswera, Lwampanga Nakasongola	FGD & KII	Involvement in manual hard labor of cutting down and burning of logs of trees weakens the participating community members. Charcoal production is a source of rural livelihood for a cross section of individuals. Smoke from the charcoal production process leads to poor human health.	Charcoal production source of fuel, income.	Moderate to High

Way forward suggested by community to curbing mycobacterial infection transmission and the associated challenges

Our study revealed concerns that little or no efforts are made available to sensitize the community about mycobacterial infection. This is augmented by the low levels of awareness among the communities about the prevention and control strategies. Some participants in one of the study district commented like this:

*“In our community, there is a common behavior of eating dead animals practiced by some of the people with the community, these people may get infected and in turn end up infecting other people..... You see in this community.....here, people also sell wild meat in the “black markets” (selling it in hiding), therefore such meats from wild animals might be infected with tuberculosis, which will affect our community members.....Our people need to be sensitized on the methods of preventing themselves from getting mycobacterial infections”* (Male FGD participant in Nabiswera subcounty, Nakasongola district Uganda).

Individuals and the communities require awareness education to curb the effect of stigmatization. Awareness education should also call for changes in social behaviors such as avoidance of eating raw, half cooked or eating meat from wild animals sold in “black markets. Routine health awareness education should encourage the pastoral communities to test for mycobacterial diseases and HIV/ AIDS.

Further awareness education should encourage community members with liaison with village health teams (VHT) to access the health services. Involvement of religious leaders the (clergy), the elderly, traditional health and community health workers was strongly emphasized.

## B. Quantitative study

This section presents the survey results summarized as percentage and proportion of the respondents with respect to the districts. Aspects covered included: community perceptions associated with mycobacterial infections transmission. The section also covers aspects of the socioeconomic aspects of the pastoral households and expenditures incurred. The survey showed that all interviewed community members (100 %) had adequate knowledge of mycobacterial infections. Locally, mycobacterial infections in *Ruruli* are called *Akasubba*, *akalakiro*, or *akakororo*, or *Luganda (Akafuba)* in humans. In animals the infection is referred to as *ruhaha*. These local names both in humans and animals literally meant that there is heavy pulmonary system involvement as well as coughing as the major symptoms of mycobacterial infections.

Table 5 shows the pastoralist community perceptions on mycobacterial infection, categorizing responses by district. In both districts (Mubende and Nakasongola), there are several socio-behavioral factors such as consumption behaviors. Consumption of raw and half cooked animal products was shown to be 47 % (140 of 301) and 14 % (43 of 301) of the respondents in Mubende and Nakasongola districts respectively. Drinking of untreated water was found in 4 % (4 of 301) of the respondents and 17 % ( 50 of 301) of the respondents. Sharing of drinking utensils and straws, and smoking as other modes of mycobacterial infection transmission at household and community level was reported in 3% and 5% in the districts of Mubende and Nakasongola respectively.

Table 5. Pastoralist community perceptions on mycobacterial infection transmission and the percentage of the respondents in the study districts (n=301) (Mubende =164, Nakasongola =137).

Variable category	Level	District				p-value
		Proportion Mubende (n=301)	%	Proportion Nakasongola (n=301)	%	
Transmission	Overcrowding & poor ventilation	1	0.3	27	9	<0.001
	Consumption of raw or half-cooked animal products	140	47	43	14	
	Drinking untreated water	13	4	50	17	
	Sharing utensils, straws and smoking	10	3	17	6	
Domestic and wild as reservoirs	Yes	164	55	137	45	-
	No	0		0	0	
Type of animals	Domestic animals	128	43	112	37	0.43
	Wildlife	36	12	25	8	
Transmission to Mode	Drinking water	110	37	92	30	<0.001
	Pastures	52	17	32	11	
	Infected humans	2	0.7	13	4	
Humans drink water from shared water source	Yes	163	54	117	39	<0.001
	No	1	0.3	20	7	
Type of domestic animal	Cattle	81	27	66	22	0.080
	Pigs	25	8	34	12	
	Cats & Poultry	58	19	37	12	
Type of wildlife	Primates	59	20	105	35	<0.001
	Bush pigs	12	4	32	11	
	Savannah species and birds	93	31	0	0	

Generally, the perception was that animals (both domestic and wild animals) are the main reservoir of mycobacterial infection transmission to humans. Results reveal that 202 of 301 (67%) of the surveyed pastoralists in both districts perceiving that animals acquire mycobacterial infections through drinking water from shared water source (wildlife, domestic animals and humans). The survey also shows that 49% (27% and 22%) of the respondents believed that animals were the source of infections in the districts of Mubende and Nakasongola respectively. Furthermore, domestic animals especially cattle, were perceived to be involved in the transmission of mycobacterial infections. On the other hand twenty percent of the respondents expressed the perception that pigs were also involved in mycobacterial infection because of the shared environment between humans and animals (pigs) which are reared under free range management system. Some believed that cats, dogs and poultry too were a source of infection. Ninety three percent of the respondents had a perception that humans acquire the infection through sharing drinking water with animals (domestic and wild species). Among wildlife, primates are the most incriminated species, and 55 % of the responds had a perception that humans were most infected by them.

Socio-behaviors related with consumption reported in the FGD and Key informant interviews in the qualitative component of this study in both districts did not differ from the above aspects reported by the respondents.

## DISCUSSION

This is the first study to qualitatively and quantitatively determine the socio-behavioral aspects of mycobacterial infection management in pastoral communities of Uganda.

Results from this study reveal that consumption of untreated water is the main route of mycobacterial infection transmission to humans. This is in agreement with previous findings on the myths knowledge attitudes, practices and perceptions associated with mycobacterial infection management in the pastoral communities of Uganda<sup>18</sup> in which pastoralists were found not to drink boiled water. Furthermore this is agreement with consistent findings that pointed out water to be the main source of mycobacterial infections especially the NTM<sup>26-27</sup>.

Consumption of raw animal- products has been revealed as key factors for mycobacterial infection transmission, a fact that is in agreement with findings by<sup>28</sup> who emphasizes the awareness that bovine tuberculosis (BTB) on the other hand can easily be transmitted to humans through consumption of raw animal products from infected animals. Despite the public health threat posed to rural pastoral community in developing countries who depend on cattle and other forms of livestock as a source of livelihood<sup>29</sup>.

This study showed that sharing of cigarette sticks, drinking straws and coughing and spitting in public was perceived to be of high risk in transmission of mycobacterial infections. This is in line with findings by<sup>11</sup> in which smoking of cigarettes and sharing of both sticks and pipes during smoking and sharing of alcohol drinking straws were perceived as modes of transmission of mycobacterial infections among the pastoral communities. The quantitative results also showed that 9% of the respondents smoked, and amazingly most of them knew that it was risk to other infections. This is scientifically in line with findings by many scholars who have documented smoking as a risk factors to acquisition of mycobacterial infections<sup>26</sup>.



Overcrowded and poor ventilated closed environments was not greatly emphasized in the qualitative component as a key fact to infection transmission, however, studies on TB have shown that overcrowding as well as poor ventilation is the major risk factor in the spreading of TB. Therefore it goes without saying that families that have an infected person are more at risk of acquiring the infection, if they are crowded.

The mixed model analysis on the other hand revealed that households that were overcrowded earned less compared to those that were not crowded. This is probably due to the fact that more crowded homesteads are more liable acquiring infections. These infections in turn could result in keeping the bread earner away from work hence that affected household earning less. Similar findings have been reported in the study done by Russell<sup>30</sup> where ill-health can cause household asset loss and income loss for households in developing countries.

This study also that revealed stigmatization is still very much a part pastoral life with regards to mycobacterial infections especially Tuberculosis, furthermore the qualitative results show the different types of stigmatizations that arose based on the choice of mycobacterial management. If pastoralist, through conventional medicine were diagnosed with mycobacterial infections like TB, they would be stigmatized because of the TB/HIV/AIDS co infections, while on the other had if they used traditional healers since some perceived that suffering from mycobacterial infections was a divine punishment, they on the other hand would be stigmatized by the mainstream Christians creating a situation of double jeopardy for sufferers. Results from this study have revealed the existence of a high degree of stigmatization, discrimination (S&D) and abandonment of the patients suffering from mycobacterial infections<sup>19</sup>. The study however found that it was difficult to capture stigmatization quantitatively and therefore was not documented. The discourse however, has been shown to have negative social ramifications on the impact of mycobacterial infections. As a result, there is every need to change individual attitudes and societal behaviors towards re-focusing the perceptions derived from social stigmatization of tuberculosis and HIV/AIDS patients.

That said, it would be of fundamental importance as well as a plausible strategy to engage respected community gate keepers including religious leaders (clergy), community health service providers including the traditional birth attendants, respected older people, traditional healers and opinion leaders in the task of changing the community's mind set and perceptions towards mycobacterial infections and HIV/AIDS. Given the negative and severely catastrophic effect on intended and/ or set intervention strategies besides the increasingly lowering the health seeking behavior (HSB) of the communities there is a great need to call for a deeper re-thinking on the way forward with regards these identified bottlenecks<sup>28, 31</sup>. There is also urgent need to foster among the pastoral community a healthy and positive community altitudinal change which will ultimately transform negative aspects such as S&D challenges including addressing risks associated with following up to grave of the patient's body and aesthetic value into positive future sustainable practices. This paradigm shift would not only positively impact on the future intervention in the control of mycobacterial infections but also enhance patient care in HIV/ AIDS and other related diseases and their campaigns.

## CONCLUSION

This study has revealed a high degree of stigmatization, discrimination (S&D) and abandonment of the patients suffering from mycobacterial infections among the pastoralist communities. Socio-consumption behaviors are perceived as the main routes for acquisition of mycobacterial infections. Overcrowding and living in close proximity with domestic animals are the most important risk factors for mycobacterial infection for pastoralist and therefore pose a health threat to the humans living at the human-animal interface

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## CONFLICT OF INTEREST

None Declared

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